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ABSTRACT

Evidence regarding the contribution of the various elements in a standard admissions battery to forecasts of freshman-year performance in eight College Research Center (CRC)-member colleges is presented. Particular note is made of evidence that the CEEB Achievement Average contributes substantially more than do the SAT scores to prediction of college performance. Results of multiple correlational analysis, which are tabulated, show that: (1) a Predicted Grade Index (PGI) based solely on School Rank and the average of CEEB achievement test scores is as closely related to actual grades as PGI based on all four scores, including the SAT's; (2) with predictions based on the SAT's the accuracy of the prediction can be improved by adding Class Rank, and CEEB Achievement Average scores add information not supplied by SAT"s or Class Rank; (3) standard score regression weights from multiple correlational analyses show that: (a) weights for Rank and Achievement Average are, by and large, greater than the weights for SAT-V or SAT-M; (b) weights for Rank and Achievement Average are positive; and (c) weights for SAT-M have negative signs, with negative weighting for SAT-V occurring less frequently. As a result of the suppression effect of the SAT's, it is recommended that operational prediction formulae for CRC-member colleges be based solely on the Achievement Average and Converted Secondary School Rank. (DB)

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CONTRIBUTION OF SAT's TO PREDICTION OF FRESHMAN GRADES AT CRC-MEMBER COLLEGES (WOMEN)

CRC MEMORANDUM, May 8, 1970

by

Kenneth M. Wilson

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COLLEGE RESEARCH CENTER
at
Educational Testing Service
Princeton, New Jersey

Contribution of SAT's to Prediction of Freshman Grades at CRC-Member Colleges (Women)*

by

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Member-colleges of College Research Center use a standard battery of admissions data in evaluating the academic qualifications of applicants, as follows:

Scholastic Aptitude Test-Verbal (SAT-V)**
Scholastic Aptitude Test-Mathematical (SAT-M)**
Converted Secondary School Rank (ConRk)
Average of scores on CEEB Achievement Tests (Ach Av)

It is the purpose of this memorandum to present evidence regarding the contribution of the various elements in the admissions battery to forecasts of freshman-year performance in eight CRC-member colleges. Particular attention is given to evidence that the CEEB Achievement Average is contributing substantially more than the SAT scores to prediction of college performance.

Recent validity studies (2,3) have pointed up the fact that of the four scores included in the standard admissions battery, namely, Converted School Rank, Average of CEEB Achievements, SAT-Verbal, and SAT-Mathematical, Rank and CEEB Ach contribute most to prediction of freshman standing. The data in Table 1 provide direct evidence on the question of the contribution of SAT's to prediction of freshman grades in CRC-member colleges.

The first column of multiple correlation coefficients in Table 1 reflects the relationship between freshman grades and best-weighted combinations of School

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* This is a slightly abridged version of the CRC Memorandum, dated May 8, 1970, same subject.

** For several years colleges have used an adjusted, or weighted average, SAT score. SAT-Verbal and SAT-Mathematical scores, respectively, have been adjusted so as to take into account the number of administrations, practice effects, and grade-levels at which the SAT was taken by a given candidate. CRC studies have shown that adjusted and "most recent" scores yield comparable validities and that the weighting does not enhance the utility of the SAT scores for prediction. For a description of the weighting procedures involved, see item (1) in the list of references.

Rank and CEEB Achievement Average, only, while the second column of coefficients represents the relationship between freshman grades when SAT-Verbal and SAT-Mathematical scores are added to Rank and Achievement.

> In sixteen comparisons, the increase in multiple correlation due to adding measures of verbal and mathematical aptitude to the two measures of school attainment was very small, averaging only .013 correlation points (average of entries in the third data-column in Table 1).
>
> This means that a Predicted Grade Index based solely on School Rank and the average of CEEB achievement test scores is as closely related to actual grades as a PGI based on all four scores, including the SAT's.
>
> Thus, omitting SAT's from the prediction formula would not result in significant loss of predictive efficiency in most of the situations studied.

Conversely, the data in Table 1A show what happens when the aptitude measures (i.e., SAT's) are augmented by measures of school attainment (i.e., Class Rank and the average of CEEB Achievement Test scores).

> When Class Rank is added to SAT's, the average increase in multiple correlation is .123, and addition of the CEEB Achievement Average results in a further average increase of .066 in the coefficients of multiple correlation.
>
> In every comparison, the increase in multiple correlation due to adding Rank was of practical significance--increases ranged between .064 and .198 correlation points--and in all but two cases the CEEB Achievement Average provided information of value for prediction beyond that supplied by SAT's and Class Rank.

The analysis in Table 1 tells us that if we start with predictions based on Class Rank and CEEB Achievement Tests we don't improve our predictions very much, if at all, by adding the SAT's. The analysis in Table 1A tells us that we start with predictions based on the SAT's we can improve accuracy of prediction by taking Class Rank into account and that, in most instances, scores on achievement tests add information not supplied either by SAT's or Class Rank. However, these analyses do not indicate how the respective scores are actually weighted when all four are treated simultaneously.

Weighting of V, M, Rank, and Ach Av

It is important to know how much and in what way each of the preadmissions measures contributes to prediction of Freshman Average Grade when they are considered jointly. Each of the variables is related to some extent with Freshman

Average Grade but they are also related to each other--i.e., they reflect to some extent, the operation of similar abilities, traits, etc.

Table 1A. Multiple Correlation with FAG of SAT's Only, SAT's plus Rank, and SAT's plus Rank and Achievement Test Scores, Class of '70, CRC-Member Colleges

	SAT-Verbal plus SAT-Math	Add Rank to aptitude		Add Ach Av to Rank & SAT's	
		R	Increase over SAT's	R	Increase over SAT's plus Rank
Connecticut	.134	.231	(.097)	.283	(.052)
Wheaton	.190	.329	(.136)	.386	(.057)
Briarcliff	.186	.295	(.109)	.439	(.144)
Hollins	.255	.453	(.198)	.525	(.072)
Vassar	.267	.364	(.097)	.380	(.016)
R-MWC	.347	.522	(.175)	.577	(.055)
Mount Holyoke	.358	.467	(.109)	.597	(.130)
Trinity	.527	.591	(.064)	.595	(.004)

One of the most useful characteristics of multiple correlational analysis is that it permits us to determine the "best-weighting" of several preadmissions variables, taking into account the redundancy or overlapping of information involved in their joint use.

Shown in Table 2 are weights, called standard score regression weights or beta weights, from multiple correlational analyses in several recent classes. These weights reflect the contribution of the respective admissions variables when they are all expressed in comparable, standard-deviation score units.

It is evident that the beta weights vary both in magnitude and in sign. In this connection we should note that:

a) consistent with the findings in Tables 1 and 1A, weights for Rank and Achievement Average (Ach Av), by and large, are greater than the weights for SAT-Verbal or SAT-Mathematical;

b) in all instances, weights for Rank and Ach Av are positive;

c) in a majority of samples, weights for SAT-Math have negative signs--with negative weighting for SAT-Verbal occurring less frequently. In such cases, the best-weighted composite for purposes of predicting freshman average grade involves subtraction of the designated proportion of SAT-Mathematical

Table 1. Contribution of SAT's to Prediction of Freshman Average Grade when Added to School Rank and CEEB Achievement Average

Group		School Rank + CEEB Ach Av R*	School Rank, CEEB Ach Av plus SAT's R*	Increase in R due to adding SAT's
Vassar	Public '72	.306	.368	.062
	Private	.484	.488	.004
Mt. Holyoke	Public '72	.423	.436	.013
	Private	.548	.574	.026
Hollins	Public '72	.538	.540	.002
	Private	.596	.597	.001
Connecticut	Public '72	.472	.485	.013
	Private	.411	.426	.015
Wheaton	Public '72	.544	.553	.009
	Private	.352	.387	.035
Briarcliff	Public '72	.4227	.4231	.0004
	Private	.446	.462	.016
R-MWC	Public '66-'67	.644	.649	.005
	Private	.584	.587	.003
Trinity	Public '66-'67	.658	.663	.005
	Private	.652	.654	.002

*Coefficient of multiple correlation, these variables versus Freshman Average Grade.

Table 2. Weights Reflecting the Contribution of Basic Entrance Measures to Prediction of Freshman Grades When Measures are Considered Jointly, Classes of '68, '70, and '72, Respectively

College	Standard score regression weights									
	Public					Private				
	SAT-V	SAT-M	Rank	AchAv	(R)	SAT-V	SAT-M	Rank	AchAv	(R)
A# '68	03	02	27	31	(42)	10	-07*	37	28	(51)
A '70	05	00	27	46	(58)	-00*	-06*	33	49	(65)
A '72	13	-01*	23	26	(44)	-20*	-06*	45	41	(57)
B '68	07	-02*	36	33	(55)	09	-02*	18	24	(34)
B '70	18	-06*	30	15	(42)	22	-05*	24	01	(35)
B '72	12	-19**	22	22	(37)	-06*	01	45	27	(49)
C '68	04	09	33	14	(41)	10	-15**	28	18	(36)
C '70	07	-01*	31	15	(37)	13	-13**	18	40	(47)
C '72	11	-07*	47	17	(55)	-09**	-16**	36	29	(39)
D '68	05	-03*	51	18	(58)	08	-25**	37	35	(53)
D '70	-06*	-21*	28	63	(64)	-09*	-00*	32	24	(41)
D '72	02	06	39	20	(54)	-02*	-04*	56	14	(60)
F '68	07	-09*	37	17	(46)	15	00	32	15	(45)
F '70	-06*	-09**	01	48	(45)	-07*	-17*	24	46	(45)
F '72	02	02	35	16	(42)	-08*	15	37	21	(46)
G '68	17	-00*	30	27	(53)	21	-02*	29	09	(37)
G '70	03	04	13	21	(26)	04	-20**	34	23	(40)
G '72	06	-11*	28	36	(48)	12	-06*	26	26	(43)
H '68	05	-03*	48	17	(58)	30	03	09	18	(45)
H '70	01	02	39	30	(56)	-14*	10	36	46	(61)
J '68	02	03	49	22	(67)	04	16	47	07	(64)
J '70	14	13	44	24	(71)	33	11	20	06	(56)

Note: All numerical entries in the table should be preceded by a decimal point. The weights shown in the first four data columns under each school-group are those which are applicable to the respective component variables (designated at head of column) when all have been expressed in comparable, standard score, units. The parenthetical entry is the coefficient of multiple correlation between the four measures (weighted as indicated) and Freshman Average Grade in the respective samples.

#These are standard letter codes for identifying CRC Colleges.

*Suppression effect--simple correlation with FAG is positive.

**Reflects negative correlation with Freshman Average Grade, prior to rounding.

and/or SAT-Verbal scores.

The first observation simply reflects what we have already inferred, namely, that measures of school performance (Rank and Ach Av) characteristically contribute more to prediction of a measure of college performance (FAC) than do SAT's. The second two observations, however, call for further examination.

Negative weights for SAT's. An independent or predictor variable is negatively weighted in a prediction formula if it is inversely (negatively) related to the dependent or criterion variable. However, under certain circumstances a predictor may be negatively weighted even though its relationship to the dependent variable is zero or positive (4,5). It is possible to increase prediction by using a variable which shows no, or low, correlation with the criterion provided it correlates well with another predictor which shows a higher correlation with the same criterion. In such cases, the variable takes a negative weight in the prediction formula indicating that by its use in conjunction with the more valid predictor something is being taken out of the more valid predictor--is being suppressed.

There have been few appraisals of the suppression effect, ". . . an interesting paradox of multiple correlation. . ." (4, p. 163), partly because it is rarely observed--or seldom reported because the overall contribution to prediction is slight and the effect resistant to replication--and partly because it is interpreted more readily in statistical than in psychological terms, hence is difficult to rationalize.

In 1965, it was found that at several CRC-member colleges (6, 7, 8, 9) SAT score(s), considered in conjunction with the CEEB Achievement Average and Converted School Rank, were operating as suppressor variables. It was noted at the time that if this phenomenon persisted, further examination of the role of SAT's would be called for. (9)

Most of the negative weights in Table 2--those marked by a single asterisk--represent samples in which the simple correlation between Freshman Grades and the SAT score(s) was positive, hence were samples in which the SAT scores, primarily SAT-M, were operating as suppressors while in only a few instances--marked by double asterisks in Table 2--does the negative beta weight represent a sample in which a negative correlation obtained between grades and SAT's.* A summary of simple correlation coefficients for the Classes of '68, '69, '70, and '72 is provided in Table 3. Coefficients marked by a

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*It might be hypothesized that girls with very high mathematical ability and associated interests and values are likely to be running counter to prevailing curricular and other patterns in women's colleges, hence are more likely to have adjustment problems than their classmates with strictly verbal orientations and interests. The Center has insufficient evidence to evaluate this hypothesis. In view of the small magnitude of the negative correlation coefficients and lack

Table 3. Correlation of Selected Entrance Measures and Combinations thereof with Freshman Average Grade, Classes of '68, '69, '70 and '72, By College and Secondary School Origin

College-Class	Public school graduates: Single predictors V	M	Rk	AA	R	PFG	Private school graduates: Single predictors V	M	Rk	AA	R	PFG
A-68	16	13	27	32	42		20	11*	41	36	51	
A-69	37	23	37	37		52	12	05	36	38		48
A-70	31	28	32	52	58	52	31*	16*	47	56	65	56
A-72	30	20*	28	35	44	43	15*	12*	48	37	57	53
B-68	20	21*	43	42	55		19	13*	21	26	34	
B-69	29	11	39	37		49	26	-03	23	29		39
B-70	27	05*	31	22	42	38	26	03*	27	10	35	24
B-72	21	-06	20	24	37	34	07*	11	42	20	49	33
C-68	10	17	35	24	41		12	-10	28	15	36	
C-69	08	21	37	33		42	06	-04	22	30		36
C-70	14	07*	32	21	37	36	26	-04	14	39	47	39
C-72	24	17*	51	30	55	42	-04	-05	29	12	39	35
D-68	13	05*	54	27	58		13	-04	41	31	53	
D-69	34	16	61	45		70	15	23	32	40		46
D-70	32*	28*	44	58	64	58	-00*	15*	35	24	41	38
D-72	18	24	46	36	54	46	25*	11*	59	28	60	57
F-68	23	13*	42	31	46		26	19	38	30	45	
F-69	Data not available						Data not available					
F-70	25*	-05	21	43	45	36	17*	09*	27	36	45	36
F-72	28	13	39	24	42	20	14*	19	37	28	46	34
G-68	32	19*	39	41	53		22	06*	27	15	37	
G-69	19	16	43	23		46	-10	05	16	06		21
G-70	12	13	11	22	26	24	13	-13	31	08	40	33
G-72	24	09*	32	39	48	46	29	08*	29	29	43	35
H-68	25	23*	55	36	58		40	21	09	37	45	
H-69	26	26	39	43		51	21	16	18	34		21
H-70	23	31	46	40	56	55	13*	24	41	47	61	58
J-68	27	49	61	43	67		39	40	63	51	64	
J-69	20	33	47	46		51	25	38	62	47		65
J-70	48	54	54	56	71	69	50	37	39	41	56	49

Note: The figures in the body of this table are correlation coefficients showing the relationship of individual entrance measures or weighted composites of these measures to Freshman Average Grade. Leading decimals have been omitted. V corresponds to SAT-Verbal, M to SAT-Math, Rk to Converted Rank, AA to Achievement Average, R to coefficient of multiple correlation between best-weighted combination of predictors and grades, and PFG to the correlation between a predictive composite and grades in a "cross-validation" situation.

*This variable operates as a suppressor--has a negative beta weight (Table 2).

single asterisk identify sample findings corresponding to similarly designated entries in Table 2.

The prevalence of negative betas for SAT's, particularly SAT-M, is noteworthy and it would seem that operation of one or both SAT scores as suppressor variables may now be characterized as a recurring phenomenon at most CRC-member colleges. At College J, for which Class-of-'72 data are not available, SAT-M operated as a suppressor in an earlier sample (6) but not in the Classes of '68 or '70. At College H, also lacking Class-of-'72 data, suppression occurred in analyses for '68 and '70.

Having identified the independent variable which is the suppressor it is important to identify the independent variable from which something is being taken out or suppressed. We need to ask what variable in the standard admissions battery is (a) a better predictor of freshman grades than the variable identified as a suppressor, and (b) also relatively closely related to the suppressor. This variable turns out to be the average of CEEB Achievement Test scores or Ach Av. The patterns of interrelationships involved are suggested by the following set of coefficients, median values of coefficients from public and private school samples, seven CRC-member colleges, Class of '68 (10):

Variables	Simple correlation							
	SAT-Verbal		SAT-Math		Ach Av		Year-1 average	
	Pub	Pvt	Pub	Pvt	Pub	Pvt	Pub	Pvt
School Rank	.06	.00	.22	.14	.18	.08	.53	.41
SAT-Verbal	---		.22	.16	.43	.42	.16	.20
SAT-Mathematical			---		.39	.47	.21	.12
Achievement Average					---		.32	.31

SAT's relate more closely to the average of achievements than to either Rank or Year-1 average, and Ach Av is a more valid predictor of Grades than either SAT-V or SAT-M. In this particular set of data a suppression effect would be found to obtain for SAT-M in the analysis for private school graduates--SAT-M has a correlation of .12 with Grades but of .47 with AchAv which in turn correlates .31 with Grades. In the circumstances, it may be argued that some of the variation in Achievement Test-score average--that representing covariation with SAT-Mathematical ability--is irrelevant (SAT-M correlates only .12 with Grades) hence must tend to lower the correlation between Achievement Average and Grades. Accordingly, elimination of the SAT-related ("irrelevant?") variance in Achievement Average should result in increased correlation with Grades--i.e., the Achievement Average score minus some portion of the SAT-M score should correlate more highly with Grades than Achievement alone. Or

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of any persuasive support for the notion that mathematical (or verbal) aptitude and freshman grades should be inversely related, it is most likely that the inverse relationships actually observed represent chance fluctuations around a population figure which approaches zero--even at College C, where the correlation between grades and SAT-M scores has been negative but quite low, approximating -.04, in several successive analyses for private school graduates. For public school grads SAT-M acts as a suppressor.

put in other terms, the correlation between freshman Grades and Achievement Average should be increased somewhat (though not much) when an appropriate portion of the non-grade-related variance which it shares with SAT-M is "eliminated" or "suppressed" by introducing SAT-M with negative weighting.

Some Implications

For several CRC-member colleges, the evidence is strong that the information provided by SAT scores adds little of value for predicting college grades after taking into account the information provided by Converted School Rank and the Average of CEEB Achievement scores. Moreover, SAT-M (and sometimes SAT-V) is being used to "refine" a more valid predictor of grades, namely, Achievement Average, so that even the typically negligible contribution to prediction is indirect--through suppression--rather than direct.

In the absence of a good psychological rationale for the suppression effect which we have identified it seems unwise to continue to include the suppressor variables in prediction formulae, particularly when doing so does not improve ability to predict first-year performance.*

Accordingly, it is recommended that operational prediction formulae for CRC-member colleges be based solely on the Achievement Average and Converted Secondary School Rank. Even at College J, where prediction is "best" and the contribution of SAT's direct, little predictive information is provided when SAT's are added to Class Rank and Achievement.

More general questions are evoked by these findings. Among these are the following.

1. How does one account for the superiority of the CEEB Achievement Tests (averaged) over the SAT's as predictors of freshman grades in the situations studied?

   If individuals are as highly selected in terms of their measured "achievement" and their demonstrated ability to perform academic tasks (i.e., in terms of secondary school rank) as they are in terms of their measured "aptitude," to what might one attribute differences in predictive validity between the achievement and the aptitude measures involved?

2. Is the type of interaction observed primarily a

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*Robert Thorndike (5) has argued the advisability of eliminating suppressor variables from a prediction battery when there is no satisfactory psychological rationale for the effect. If SAT's are not included in regression equations for predicting freshman grades how should they be used in the appraisal of candidates? What functions are served by SAT-type information? These and other questions call for further analysis.

function of contextual factors (degree of selectivity, differential selection on various elements of the admissions battery, type of institution, sex, curricular emphases, etc.) or does it have broader import, e.g., for the question of "aptitude" versus "achievement" in admissions testing, or the role of "aptitude" and "achievement" tests?

Few colleges use the average of CEEB Achievement Tests in conjunction with SAT's and Rank. We do not have evidence from a wide range of settings as to the interaction of all these variables in prediction formulae. This type of evidence is needed in order to assess the relative efficacy of "achievement tests" and "aptitude tests" as predictors of college performance at various levels.

3. It is reasonable to assert that achievement reflects aptitude, application, and opportunity. Is the Achievement Average better than the SAT as a predictor of college performance because it is a "more complex" measure of "aptitude?"* Because, by virtue of possible differences in reference populations involved, achievement tests have become "better" measures of "aptitude" for students in the upper 10 to 15 percent of the SAT distribution than the SAT's themselves?

It is important to pursue questions of this type. Empirical evidence should be sought regarding the relative contribution of Class Rank, CEEB Achievement Tests, and SAT's in college prediction contexts. One asks immediately, for example, whether these findings for women students attending selective liberal arts colleges (predominantly) for women would hold for students in a wide range of collegiate settings.

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*It is important to keep in mind that ". . .Achievement Average better than the SAT. . ." is a contextually circumscribed statement. Correlational findings and regression-based formulae reflect complex sets of interrelationships observed in specified multivariate distributions. Evidence from a variety of settings is needed in order to determine whether or not this statement might be generalized, and under what circumstances.

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10. "Validity of a Measure of 'Academic Motivation,'" CRC Research Memorandum 66-2, 13 June 1966. This memorandum shows that a self-report measure of student attitudes and work habits provides information of value for predicting freshman average grade beyond that provided in the complete standard admissions battery. It also considers the problems involved in using self-report information in admissions as opposed to counseling situations.